



AVTECH ELECTROSYSTEMS LTD.

NANOSECOND WAVEFORM ELECTRONICS
SINCE 1975

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BOX 5120, LCD MERIVALE
OTTAWA, ONTARIO
CANADA K2C 3H5

INSTRUCTIONS

AVNN SERIES

25 MHz TO 200 MHz

HIGH SPEED PULSE GENERATOR

WITH 100 ps RISE TIMES

SERIAL NUMBER: _____

WARRANTY

Avtech Electrosystems Ltd. warrants products of its manufacture to be free from defects in material and workmanship under conditions of normal use. If, within one year after delivery to the original owner, and after prepaid return by the original owner, this Avtech product is found to be defective, Avtech shall at its option repair or replace said defective item. This warranty does not apply to units which have been disassembled, modified or subjected to conditions exceeding the applicable specifications or ratings. This warranty is the extent of the obligation assumed by Avtech with respect to this product and no other warranty or guarantee is either expressed or implied.

TECHNICAL SUPPORT

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Manual Reference: /filesserver1/officefiles/instructword/avnn/avnn-1-c,edition5.odt.

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INTRODUCTION

The AVNN series of pulse generators are high performance instruments capable of operating at pulse repetition frequencies from 25 MHz to 200 MHz, with 100 ps rise and fall times. The output duty cycle may vary from 30% to 70%.

Model AVNN-1-C generates amplitudes as high as 5 Volts (peak-to-peak).

The output is designed to drive 50 Ω loads. (A 50 Ω load is required for proper operation.) The output is AC-coupled.

This instrument is intended for use in research, development, test and calibration laboratories by qualified personnel.

AVAILABLE OPTIONS

-OT Option: an internally generated DC offset, controlled by a front-panel dial, can be added to the output.

SPECIFICATIONS

Model ¹ :	AVNN-1-C
Amplitude ^{2,3} : (50 Ohm load)	Variable to 5 Volts (peak to peak)
Pulse width (FWHM):	Variable, 1 ns to 30 ns (subject to duty cycle limits, see below)
Pulse repetition frequency (PRF):	25 MHz to 200 MHz
Rise & fall times (20%-80%):	≤ 100 ps
Duty cycle:	Variable, 30% to 70%
Output coupling ³ :	AC. The output waveform is bipolar. The DC component (the average of the waveform) is zero.
Propagation delay:	≤ 5 ns (Ext trig in to pulse out)
Jitter:	± 15 ps (Ext trig in to pulse out)
DC offset or bias insertion ⁴ :	Apply required DC offset to back panel solder terminals (± 50 Volts, 250 mA max)
Trigger required:	External trigger mode: ECL-logic-level (LOW = -1.6V, HIGH = -0.8V) square wave with 50% duty cycle. The trigger input is terminated by 50 Ohms to -2V internally.
Sync output:	400 mV square wave, AC-coupled. Must be terminated with 50 Ohms to ground.
Monitor output:	Provides a 20 dB attenuated coincident replica of main output
Connectors:	Out: SMA, Trig: BNC, Sync: BNC, Monitor: SMA
Dimensions (H x W x D):	100 mm x 430 mm x 375 mm (3.9" x 17" x 14.8")
Power, Temperature range:	100-240 Volts, 50-60 Hz. +5°C to +40°C.

1) -C suffix indicates stand-alone lab instrument with internal clock and line powering. No suffix indicates miniature module requiring DC power and external trigger. (See <http://www.avtechpulse.com/formats> for details of the basic instrument formats).

2) For operation at amplitudes of less than 20% of full-scale, best results will be obtained by setting the amplitude near full-scale and using external attenuators on the output.

3) The high duty cycle waveform is AC-coupled and so the output is bipolar. A unipolar output may be obtained by inserting a DC offset.

4) To specify the internally-generated DC offset option (0 to ±5 V, one-turn control) add the suffix -OT to the model number.

REGULATORY NOTES

FCC PART 18

This device complies with part 18 of the FCC rules for non-consumer industrial, scientific and medical (ISM) equipment.

This instrument is enclosed in a rugged metal chassis and uses a filtered power entry module (where applicable). The main output signal is provided on a shielded connector that is intended to be used with shielded coaxial cabling and a shielded load. Under these conditions, the interference potential of this instrument is low.

If interference is observed, check that appropriate well-shielded cabling is used on the output connectors. Contact Avtech (info@avtechpulse.com) for advice if you are unsure of the most appropriate cabling. Also, check that your load is adequately shielded. It may be necessary to enclose the load in a metal enclosure.

If any of the connectors on the instrument are unused, they should be covered with shielded metal "dust caps" to reduce the interference potential.

This instrument does not normally require regular maintenance to minimize interference potential. However, if loose hardware or connectors are noted, they should be tightened. Contact Avtech (info@avtechpulse.com) if you require assistance.

EC DECLARATION OF CONFORMITY



We Avtech Electrosystems Ltd.
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 Ottawa, Ontario
 Canada K2C 3H5

declare that this pulse generator meets the intent of Directive 2004/108/EG for Electromagnetic Compatibility. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 50081-1 Emission

EN 50082-1 Immunity

and that this pulse generator meets the intent of the Low Voltage Directive 2006/95/EC. Compliance pertains to the following specifications as listed in the official Journal of the European Communities:

EN 61010-1:2001 Safety requirements for electrical equipment for measurement, control, and laboratory use

DIRECTIVE 2011/65/EU (RoHS)

We Avtech Electrosystems Ltd.
P.O. Box 5120, LCD Merivale
Ottawa, Ontario
Canada K2C 3H5

declare that, to the best of our knowledge, all electrical and electronic equipment (EEE) sold by the company are in compliance with Directive 2011/65/EU of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (also known as “RoHS Recast”). In addition, this declaration of conformity is issued under the sole responsibility of Avtech Electrosystems Ltd. Specifically, products manufactured do not contain the substances listed in the table below in concentrations greater than the listed maximum value.

<i>Material/Substance</i>	<i>Threshold level</i>
Lead (Pb)	< 1000 ppm (0.1% by mass)
Mercury (Hg)	< 1000 ppm (0.1% by mass)
Hexavalent Chromium (Cr6+)	< 1000 ppm (0.1% by mass)
Polybrominated Biphenyls (PBB)	< 1000 ppm (0.1% by mass)
Polybrominated Diphenyl ethers (PBDE)	< 1000 ppm (0.1% by mass)
Cadmium (Cd)	< 100 ppm (0.01% by mass)

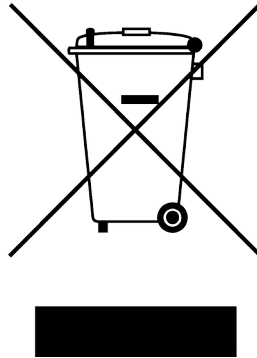
DIRECTIVE 2002/96/EC (WEEE)

European customers who have purchased this equipment directly from Avtech will have completed a “WEEE Responsibility Agreement” form, accepting responsibility for WEEE compliance (as mandated in Directive 2002/96/EC of the European Union and local laws) on behalf of the customer, as provided for under Article 9 of Directive 2002/96/EC.

Customers who have purchased Avtech equipment through local representatives should consult with the representative to determine who has responsibility for WEEE

compliance. Normally, such responsibilities with lie with the representative, unless other arrangements (under Article 9) have been made.

Requirements for WEEE compliance may include registration of products with local governments, reporting of recycling activities to local governments, and financing of recycling activities.



AC POWER SUPPLY REGULATORY NOTES

This instrument converts the AC input power to the +24V DC voltage that powers the internal circuitry of this instrument using a Tamura AAD130SD-60-A switching power supply. According to the manufacturer, the Tamura AAD130SD-60-A has the following certifications:

UL60950-1
IEC60950 -1
CSA C22.2 No. 60950- 1
EN60950 -1

and is compliant with:

EN61000-3-2
EN61000-4-2 Level 2
EN61000-4-2 Level 3 (Air Only)
EN61000-4-4 Level 3
EN61000-4-5 Level 3
EN61000-4-11
CISPR 11 and 22 FCC Part 15 Class B (conducted)

INSTALLATION

VISUAL CHECK

After unpacking the instrument mainframe and the transformer module, examine to ensure that they have not been damaged in shipment. Visually inspect all connectors, knobs, and handles. Confirm that a power cord and an instrumentation manual (this manual), are with the instrument. If the instrument has been damaged, file a claim immediately with the company that transported the instrument.

POWER RATINGS

This instrument is intended to operate from 100 - 240 V, 50 - 60 Hz.

The maximum power consumption is 90 Watts. Please see the “FUSES” section for information about the appropriate AC and DC fuses.

This instrument is an “Installation Category II” instrument, intended for operation from a normal single-phase supply.

CONNECTION TO THE POWER SUPPLY


An IEC-320 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket. The other end of the detachable power cord plugs into the local mains supply. Use only the cable supplied with the instrument. The mains supply must be earthed, and the cord used to connect the instrument to the mains supply must provide an earth connection. (The supplied cord does this.)

 Warning: Failure to use a grounded outlet may result in injury or death due to electric shock. This product uses a power cord with a ground connection. It must be connected to a properly grounded outlet. The instrument chassis is connected to the ground wire in the power cord.

The table below describes the power cord that is normally supplied with this instrument, depending on the destination region:

Destination Region	Description	Option	Manufacturer	Part Number
United Kingdom, Hong Kong, Singapore, Malaysia	BS 1363, 230V, 50 Hz	-AC00	Qualtek	370001-E01
Australia, New Zealand	AS 3112:2000, 230-240V, 50 Hz	-AC01	Qualtek	374003-A01
Continental Europe, Korea, Indonesia, Russia	European CEE 7/7 "Schuko" 230V, 50 Hz	-AC02	Qualtek	364002-D01
North America, Taiwan	NEMA 5-15, 120V, 60 Hz	-AC03	Qualtek	312007-01
Switzerland	SEV 1011, 230V, 50 Hz	-AC06	Qualtek	378001-E01
South Africa, India	SABS 164-1, 220-250V, 50 Hz	-AC17	Volex	2131H 10 C3
Japan	JIS 8303, 100V, 50-60 Hz	-AC18	Qualtek	397002-01
Israel	SI 32, 220V, 50 Hz	-AC19	Qualtek	398001-01
China	GB 1002-1, 220V, 50 Hz	-AC22	Volex	2137H 10 C3

PROTECTION FROM ELECTRIC SHOCK

 Operators of this instrument must be protected from electric shock at all times. The owner must ensure that operators are prevented access and/or are insulated from every connection point. In some cases, connections must be exposed to potential human contact. Operators must be trained to protect themselves from the risk of electric shock. This instrument is intended for use by qualified personnel who recognize shock hazards and are familiar with safety precautions required to avoid possibly injury. In particular, operators should:

1. Keep exposed high-voltage wiring to an absolute minimum.
2. Wherever possible, use shielded connectors and cabling.
3. Connect and disconnect loads and cables only when the instrument is turned off.
4. Keep in mind that all cables, connectors, oscilloscope probes, and loads must have an appropriate voltage rating.
5. Do not attempt any repairs on the instrument, beyond the fuse replacement procedures described in this manual. Contact Avtech technical support (see page 2 for contact information) if the instrument requires servicing. Service is to be performed solely by qualified service personnel.

ENVIRONMENTAL CONDITIONS

This instrument is intended for use under the following conditions:

1. indoor use;
2. altitude up to 2 000 m;
3. temperature 5 °C to 40 °C;
4. maximum relative humidity 80 % for temperatures up to 31 °C decreasing linearly to 50 % relative humidity at 40 °C;
5. Mains supply voltage fluctuations up to ± 10 % of the nominal voltage;
6. no pollution or only dry, non-conductive pollution.

FUSES

This instrument contains four fuses. All are accessible from the rear-panel. Two protect the AC prime power input, and two protect the internal DC power supplies. The locations of the fuses on the rear panel are shown in the figure below:



AC FUSE REPLACEMENT

To physically access the AC fuses, the power cord must be detached from the rear panel of the instrument. The fuse drawer may then be extracted using a small flat-head screwdriver, as shown below:



DC FUSE REPLACEMENT

The DC fuses may be replaced by inserting the tip of a flat-head screwdriver into the fuse holder slot, and rotating the slot counter-clockwise. The fuse and its carrier will then pop out.

FUSE RATINGS

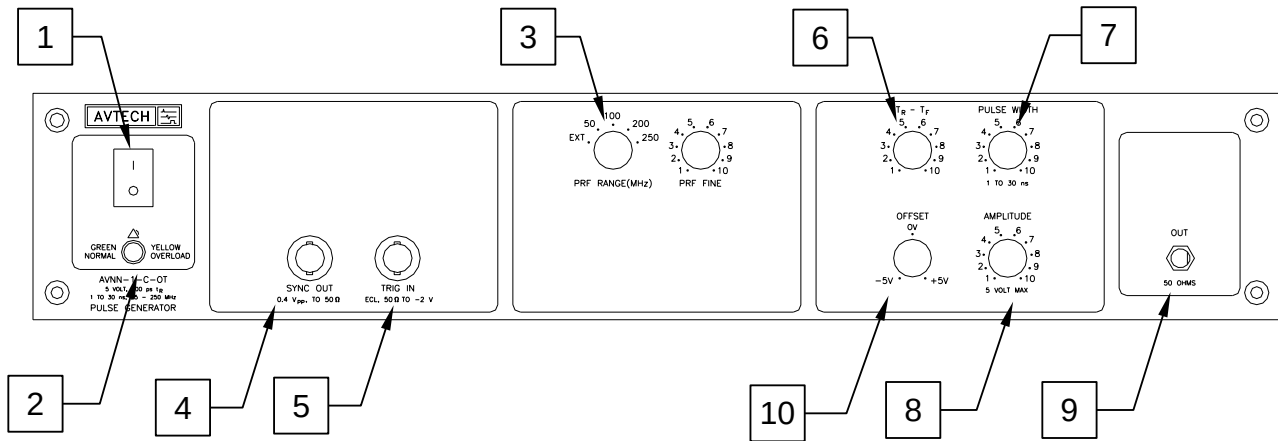
The following table lists the required fuses:

Fuses	Nominal Mains Voltage	Rating	Case Size	Recommended Replacement Part	
				Littelfuse Part Number	Digi-Key Stock Number
#1, #2 (AC)	115 V	0.8A, 250V, Time-Delay	5×20 mm	0218.800HXP	F2418-ND
	230 V	0.5A, 250V, Time-Delay	5×20 mm	0218.500HXP	F2416-ND
#3 (DC)	N/A	3.15A, 250V, Time-Delay	5×20 mm	02183.15HXP	F2430-ND
#4 (DC)	N/A	2.5A, 250V, Time-Delay	5×20 mm	021802.5HXP	F2427-ND

The recommended fuse manufacturer is Littelfuse (<http://www.littelfuse.com>).

Replacement fuses may be easily obtained from Digi-Key (<http://www.digikey.com>) and other distributors.

FRONT PANEL CONTROLS



1. POWER Switch. This is the main power switch. When turning the instrument on, there may be a delay of several seconds before the instrument appears to respond.
2. OVERLOAD Indicator. When the instrument is powered, this indicator is normally green, indicating normal operation. If this indicator is yellow, an internal automatic overload protection circuit has been tripped. If the unit is overloaded (by operating at an exceedingly high duty cycle or by operating into a very low impedance), the protective circuit will disable the output of the instrument and turn the indicator light yellow. The light will stay yellow (i.e. output disabled) for about 5 seconds after which the instrument will attempt to re-enable the output (i.e. light green) for about 1 second. If the overload condition persists, the output will be disabled again (i.e. light yellow) for another 5 seconds. If the overload condition has been removed, the instrument will resume normal operation.

This overload indicator may flash yellow briefly at start-up. This is not a cause for concern.

Note that the output stage will safely withstand a short-circuited load condition.

3. PRF Range Switch. This switch sets the pulse repetition frequency (PRF) range of the internal oscillator. The marked value of each position is the upper limit of the 2:1 range, approximately. The vernier dial beside the switch varies the PRF within the set range.

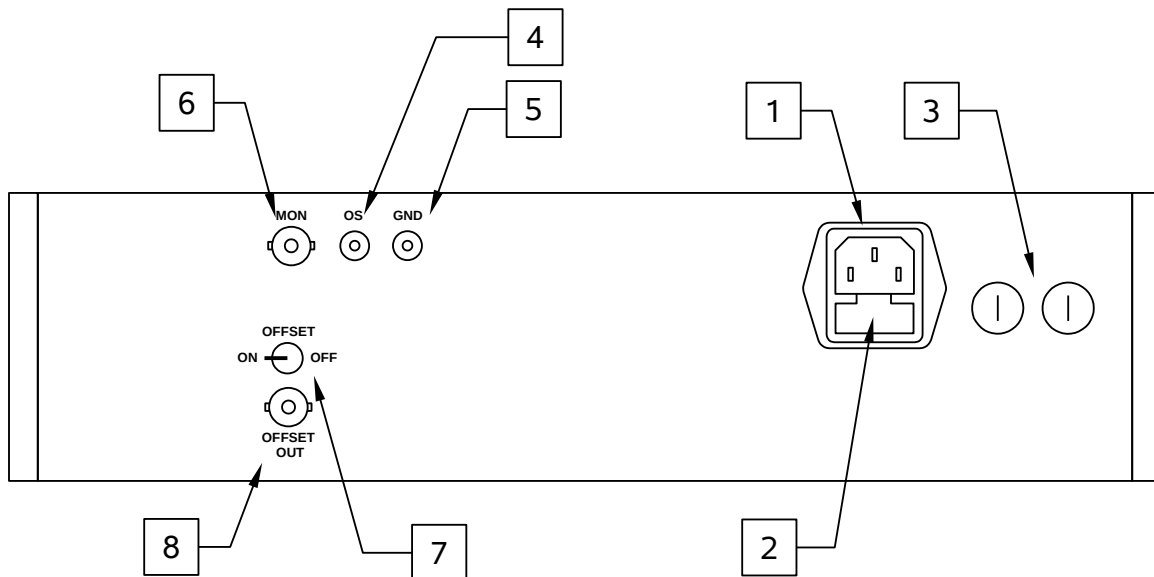
If this switched is set to the “EXT” position, the instrument is triggered by a signal applied to the TRIG connector, rather than by the internal oscillator.

4. TRIG Connector. When the PRF Range Switch is set to “EXT”, the instrument is triggered by an ECL-level (LOW = -1.6V, HIGH = -0.8V) square wave (50% duty cycle) applied to this connector. This input is terminated internally with 50 Ohms

to -2V.

5. SYNC Connector. This output may be used to trigger oscilloscopes or other equipment. It is active in both the internal and external trigger modes. This output provides an AC-coupled 400 mV (peak-to-peak) square wave with the same pulse repetition frequency as the main output.
6. TR-TF Controls. This dial controls the rise and fall times, as well as the flatness of the pulse top. Adjust as required.
7. PW Control. This dial varies the output pulse width / duty cycle. The duty cycle may be adjusted from approximately 30% to 70%.
8. AMP Control. This dial varies the output pulse amplitude from zero to maximum output.
9. OUT Connector. This SMA connector provides the main output to a 50 Ohm load.
10. OFFSET Control. (Present units with the -OT option only.) This controls the DC offset added to the output, in the range of -5V to +5V. The rear-panel OT On/Off switch must be in the "On" position for this function to be enabled.

REAR PANEL CONTROLS



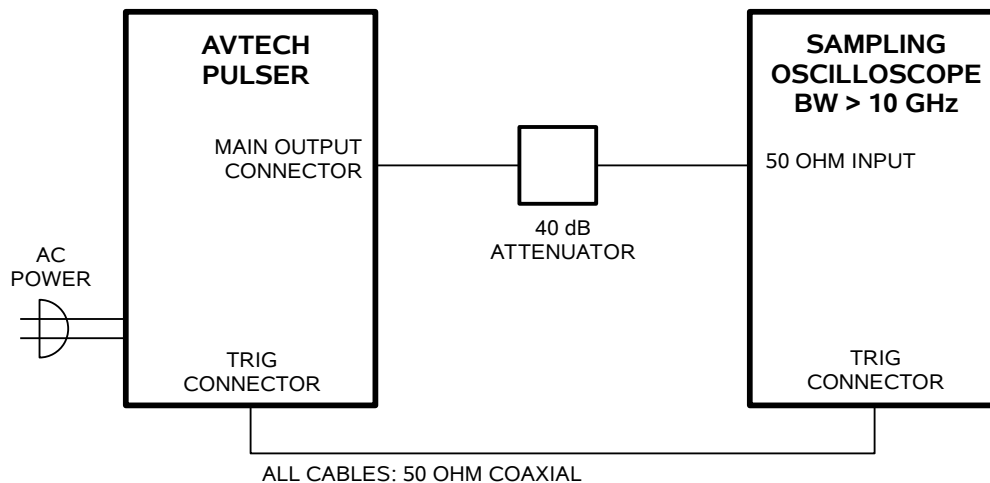
1. AC POWER INPUT. An IEC-320 C14 three-pronged recessed male socket is provided on the back panel for AC power connection to the instrument. One end of the detachable power cord that is supplied with the instrument plugs into this socket.
2. AC FUSE DRAWER. The two fuses that protect the AC input are located in this drawer. Please see the “FUSES” section of this manual for more information.
3. DC FUSES. These two fuses protect the internal DC power supplies. Please see the “FUSES” sections of this manual for more information.
4. OS INPUT CONNECTOR. (For units without the -OT option.) A DC offset in the range of $\pm 50\text{V}$ (250 mA max) may be applied to this solder terminal. The DC offset will appear on the output. When this feature is not used, the OS input should be connected to ground (using the adjacent GND connector). This is especially important when driving loads containing a diode.
5. GND CONNECTOR. (For units without the -OT option.) This solder terminal is connected to ground. It may be used to ground the OS input connector.
6. M OUTPUT CONNECTOR. This SMA connector output provides a 20 dB attenuated coincident replica of main output, for monitoring purposes.
7. OT ON/OFF SWITCH. (Present on units with -OT option only.) This switch enables or disables the front-panel offset dial and the associated internal offset generation circuitry.

8. OT OUT CONNECTOR. (Present on units with -OT option only.) This BNC connector provides access to the internally-generated DC offset voltage when the OT ON/OFF switch is set to "ON".

GENERAL INFORMATION

BASIC TEST ARRANGEMENT

The AVNN-1-C should be tested with a sampling oscilloscope with a bandwidth of at least 10 GHz to properly observe the high-speed waveform. A typical test arrangement is shown below:



The attenuator is required to prevent damage to the sampling oscilloscope.

SHAPING THE OUTPUT PULSE

In general, the TR-TF dial controls the switching times (rise and fall times), the PW dial controls the pulse widths, and the AMP dial controls the amplitude. However, these must be adjusted together to obtain the best output shape. All controls will interact to some extent. The shape will also vary as a function of PRF.

GENERAL OPERATING NOTES

- 1) The bandwidth capability of components and instruments used to display the pulse generator output signal (attenuators, cables, connectors, etc.) should exceed 10 GHz.
- 2) The use of 40 dB attenuator at the sampling scope vertical input channel will ensure a peak input signal to the sampling scope of less than 1 Volt.
- 3) The SYNC output provides a 400 mV square wave (to 50 Ohms).
- 4) To obtain a stable output display the PRF and PRF FINE controls on the front panel should be set mid-range initially.

- 5) To obtain a stable output display the PW and TR-TF controls on the front panel should be set mid-range initially.
- 6) Clockwise rotation of the PW control increases the output duty cycle. Adjust for desired output pulse width (30 to 70% duty cycle).
- 7) The desired output amplitude is controlled primarily by the AMP control and partially by the TR-TF control. The TR-TF control also serves to sharpen the rise and fall times and to flatten the pulse top. Several iterative adjustments of the AMP and TR-TF controls may be necessary to simultaneously obtain the desired output amplitude while maintaining excellent pulse rise-fall times and flatness.
- 8) To trigger externally, set the INT-EXT switch to EXT and connect an ECL-level square-wave generator to the TRIG connector. The output PRF will equal the sine wave PRF. The input duty cycle should be 50%.
- 9) To add a DC offset to the output pulse, connect a DC power supply set to required DC offset value to the back panel terminals marked "OS". The maximum attainable DC offset voltage is ± 50 Volts (for units without the -OT option only).

MINIMIZING WAVEFORM DISTORTIONS

USE 50 OHM TRANSMISSION LINES AND LOADS

Connect the load to the pulse generator with 50 Ω transmission lines (e.g. RG-58, RG-174, or RG-316 cable).

This instrument requires a 50 Ω load for proper operation. It will not properly drive a high-impedance load. The output stage will be damaged if it is operated into an open circuit (or any other high impedance). Failures due to improper output loading are not covered by the warranty.

USE LOW-INDUCTANCE LOADS

Lenz's Law predicts that for an inductive voltage spike will be generated when the current through an inductance changes. Specifically, $V_{\text{SPIKE}} = L \times di_{\text{LOAD}}/dt$, where L is the inductance, i_{LOAD} is the load current change, and t is time. For this reason, it is important to keep any parasitic in the load low. This means keeping wiring short, and using low inductance components. In particular, wire-wound resistors should be avoided.

PREVENTING DAMAGE

The AVNN-1-C may fail if triggered at a PRF greater than 200 MHz.

This unit is designed to operate into a load impedance of 50 Ohms and the output stage will be damaged if it is operated into an open circuit (or any other high impedance). Failures due to improper output loading are not covered by the warranty.

The lifetime of the switching elements in the pulse generator module is proportional to the running time of the instrument. For this reason the prime power to the instrument should be turned off when the instrument is not in use.

MECHANICAL INFORMATION

TOP COVER REMOVAL

If necessary, the interior of the instrument may be accessed by removing the four Phillips screws on the top panel. With the four screws removed, the top cover may be slid back (and off).

 Always disconnect the power cord and allow the instrument to sit unpowered for 10 minutes before opening the instrument. This will allow any internal stored charge to discharge.

There are no user-adjustable internal circuits. For repairs other than fuse replacement, please contact Avtech (info@avtechpulse.com) to arrange for the instrument to be returned to the factory for repair. Service is to be performed solely by qualified service personnel.

 Caution: High voltages are present inside the instrument during normal operation. Do not operate the instrument with the cover removed.

ELECTROMAGNETIC INTERFERENCE

To prevent electromagnetic interference with other equipment, all used outputs should be connected to shielded loads using shielded coaxial cables. Unused outputs should be terminated with shielded coaxial terminators or with shielded coaxial dust caps, to prevent unintentional electromagnetic radiation. All cords and cables should be less than 3m in length.

MAINTENANCE

REGULAR MAINTENANCE

This instrument does not require any regular maintenance.

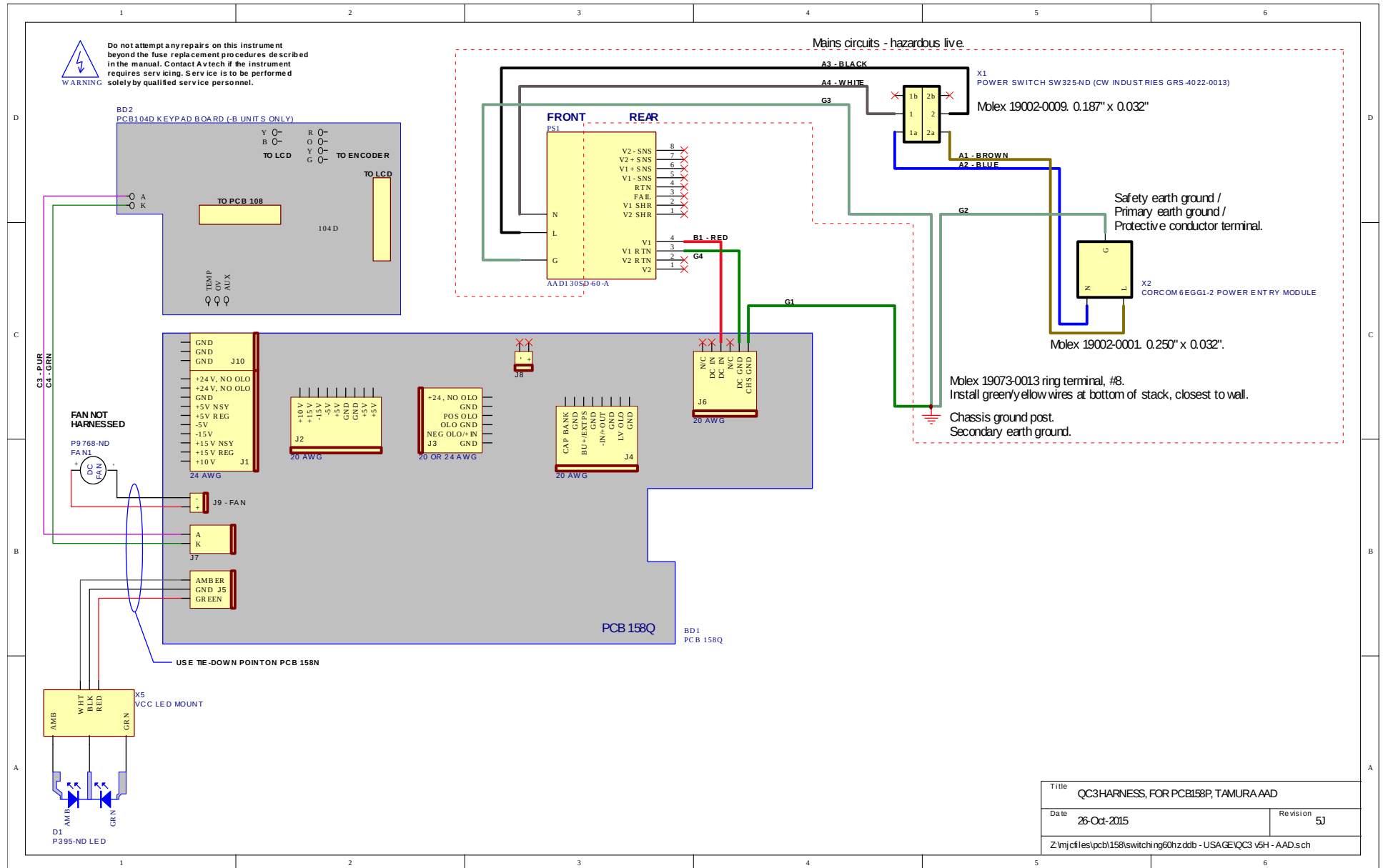
On occasion, one or more of the four rear-panel fuses may require replacement. All fuses can be accessed from the rear panel. See the “FUSES” section for details.

CLEANING

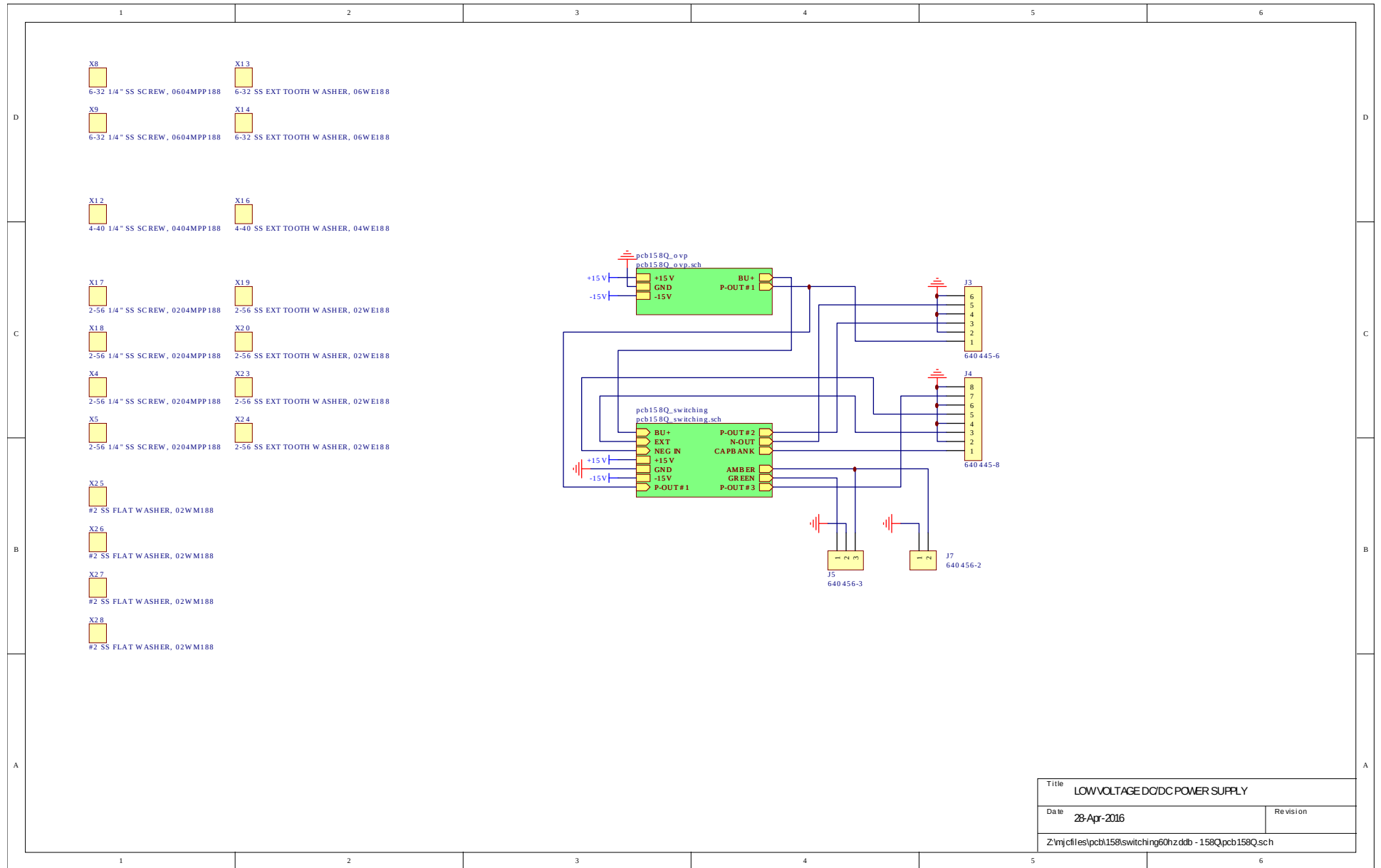
If desired, the interior of the instrument may be cleaned using compressed air to dislodge any accumulated dust. (See the “TOP COVER REMOVAL” section for instructions on accessing the interior.) No other cleaning is recommended.

WIRING DIAGRAMS

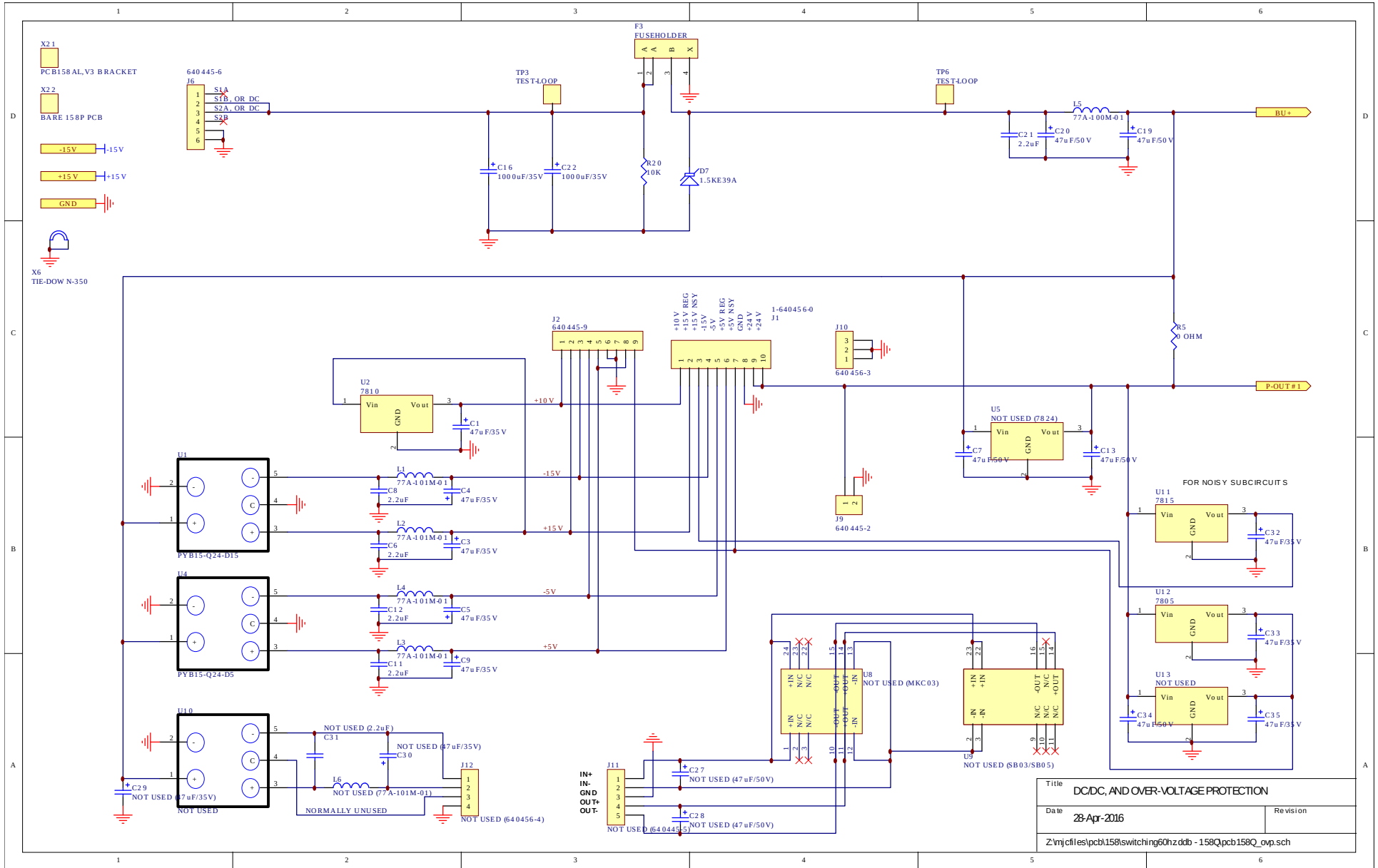
WIRING OF AC POWER



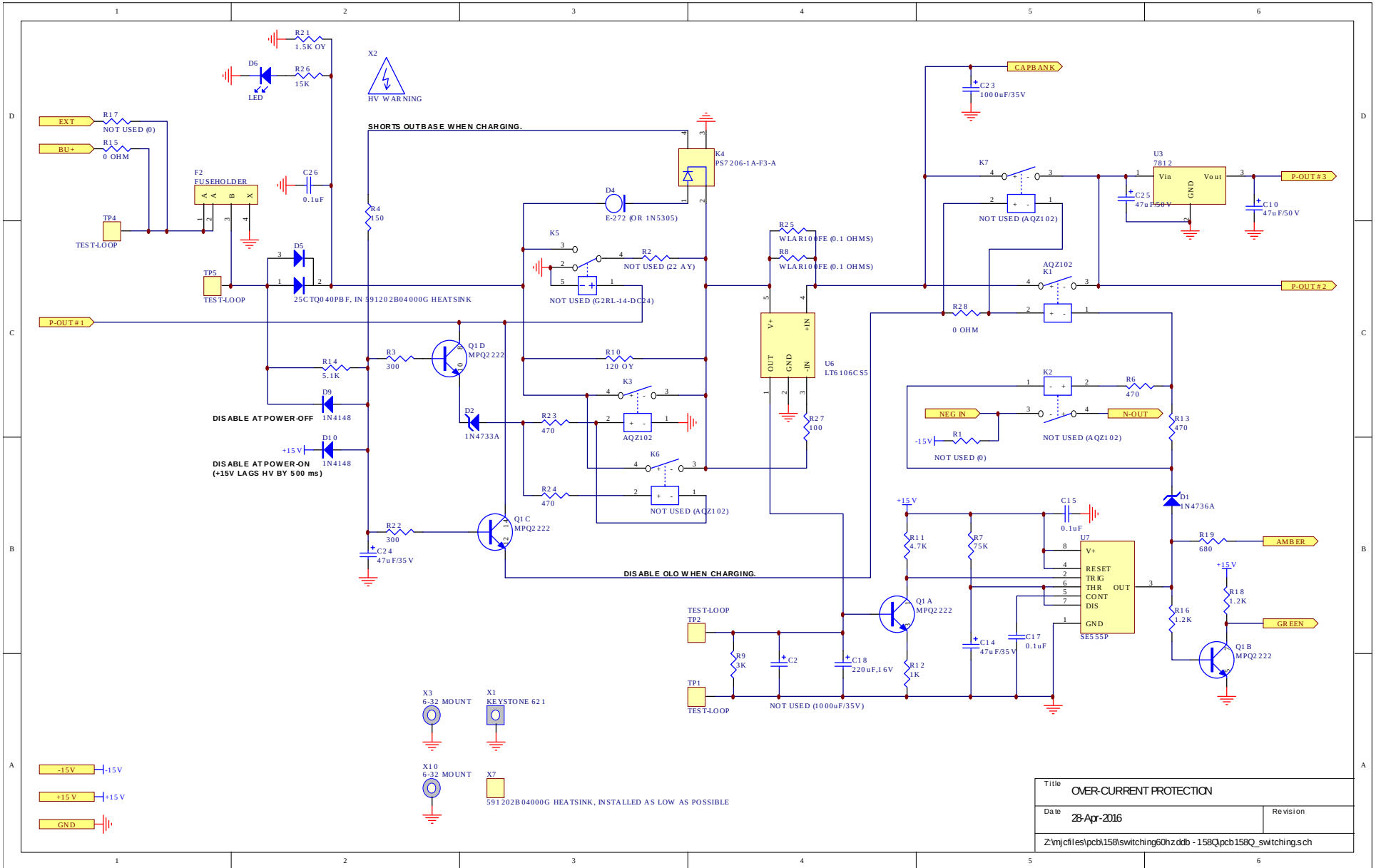
PCB 158Q - LOW VOLTAGE POWER SUPPLY, 1/3



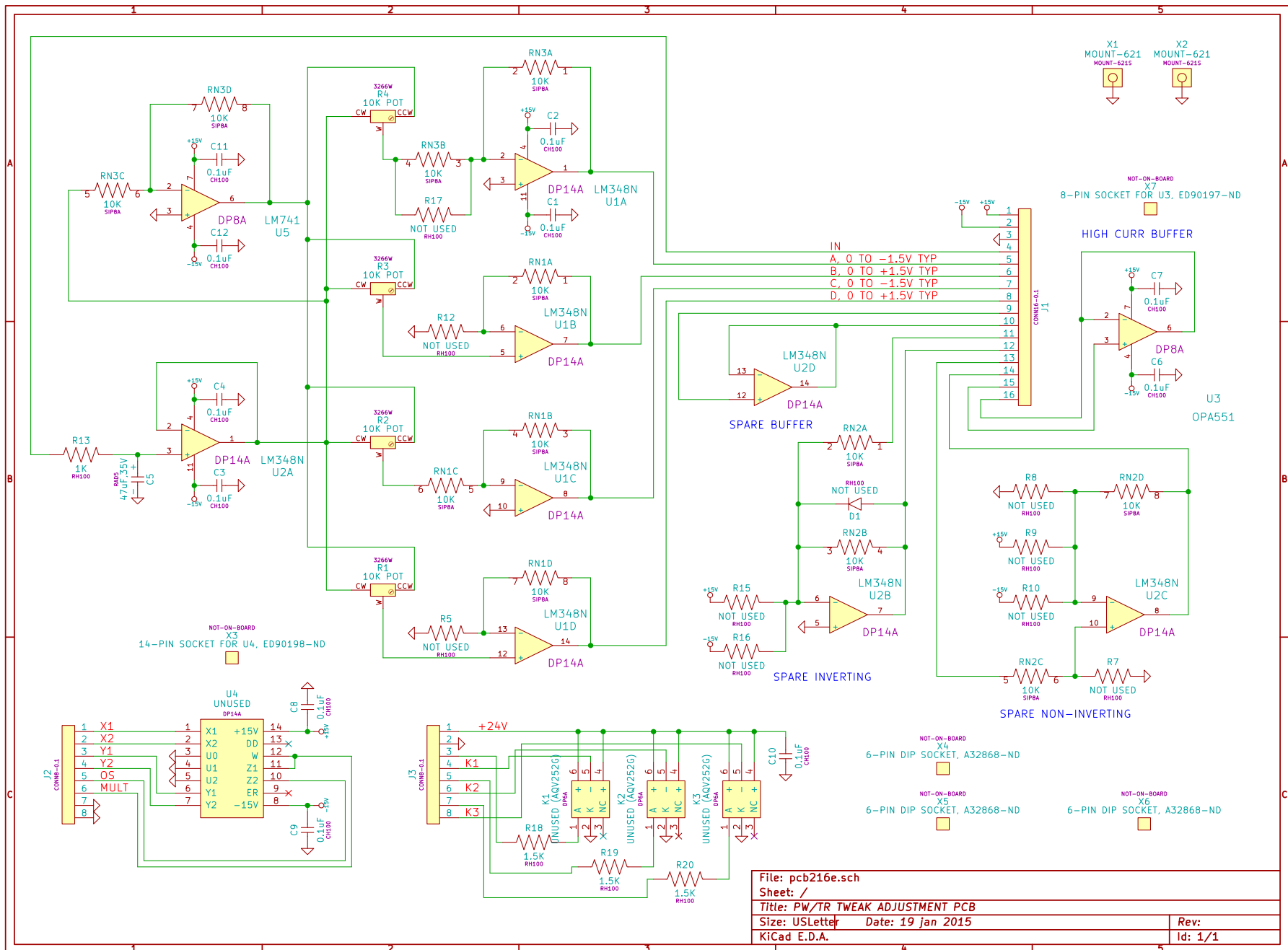
PCB 158Q - LOW VOLTAGE POWER SUPPLY, 2/3



PCB 158Q - LOW VOLTAGE POWER SUPPLY, 3/3

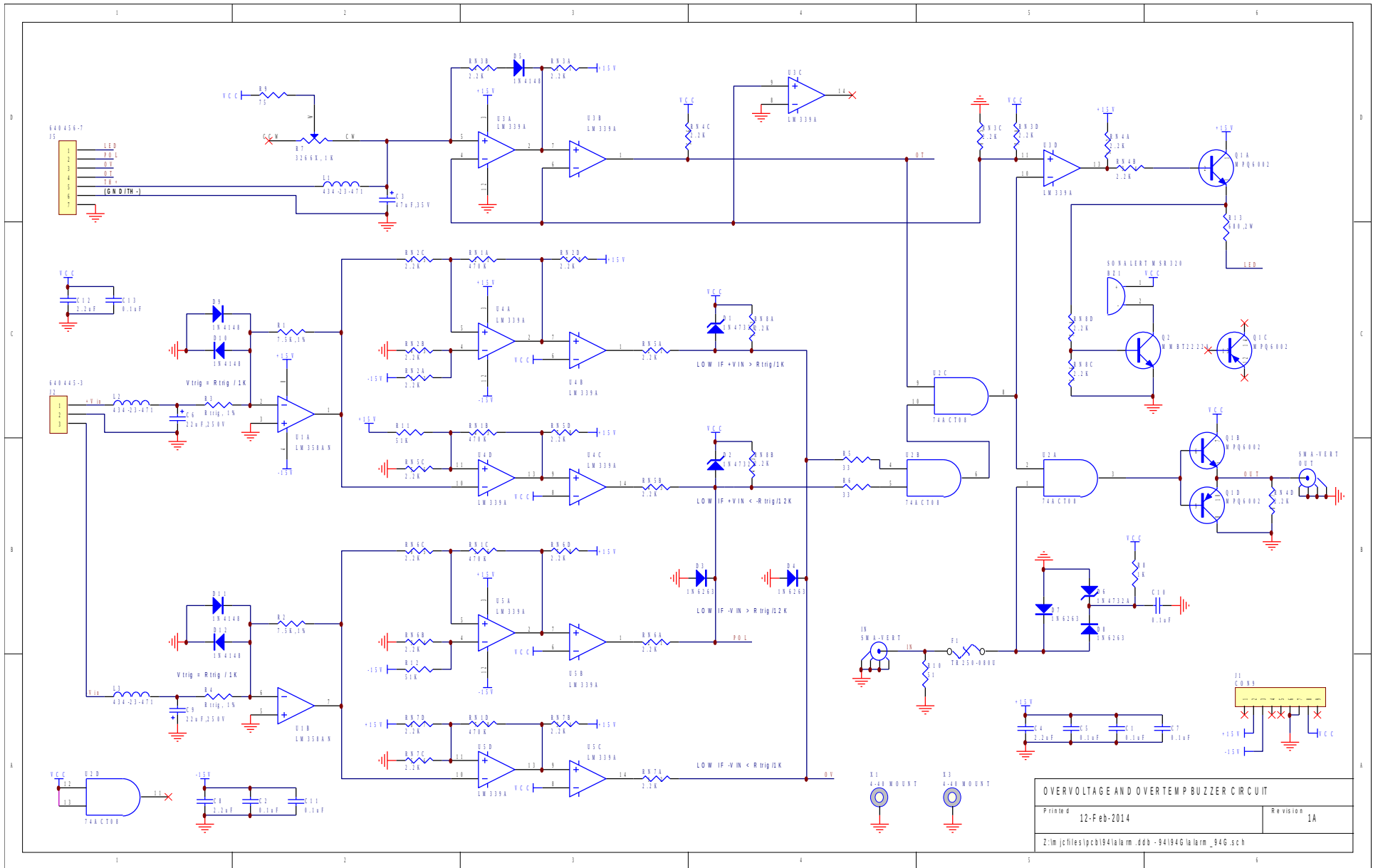


PCB 216E - PRF/PW TWEAKING PCB

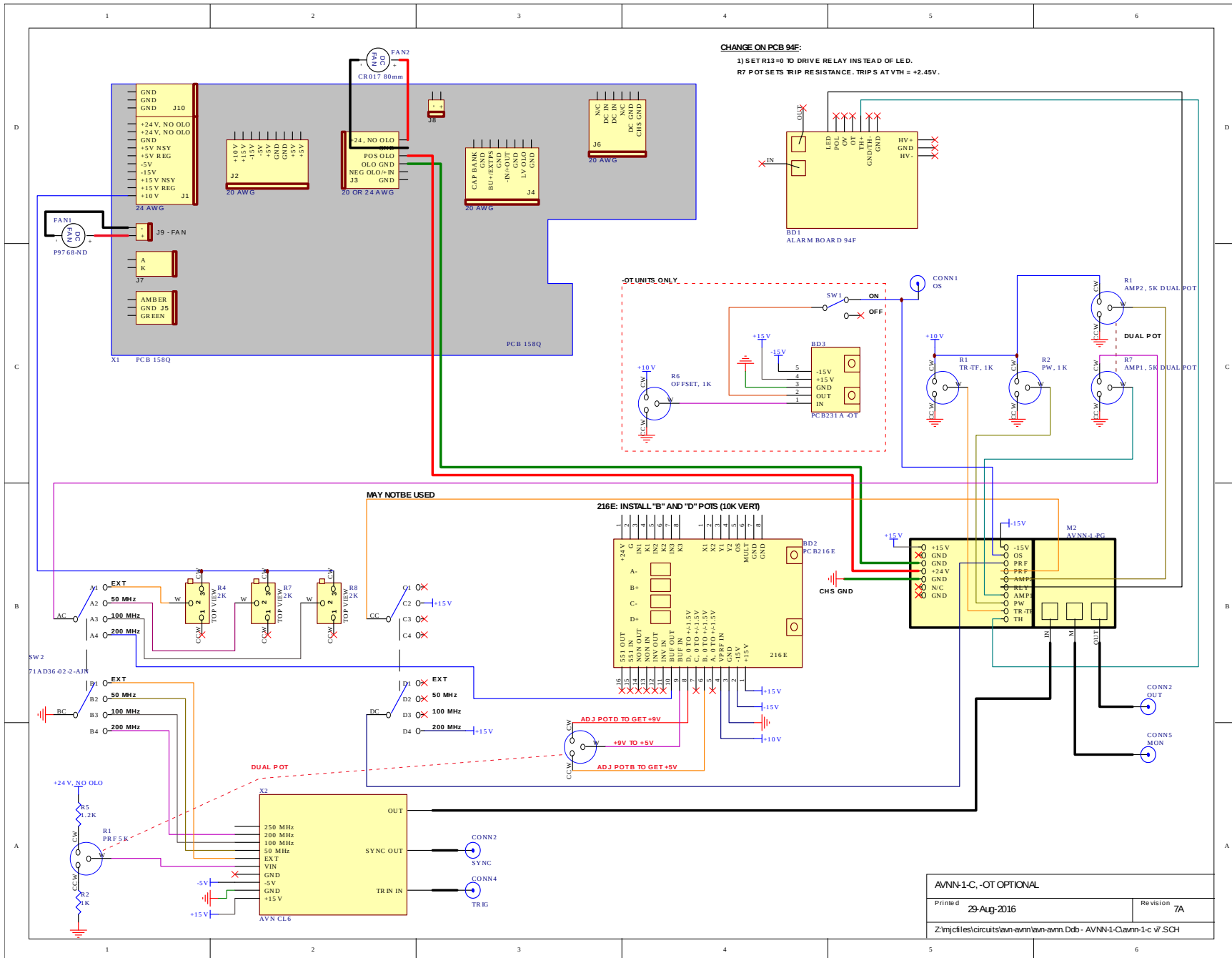


File: pcb216e.sch	Rev:
Sheet: /	Id: 1/1
Title: PW/TR TWEAK ADJUSTMENT PCB	
Size: USLetter Date: 19 jan 2015	
KiCad E.D.A.	

PCB 94G - ALARM BOARD



MAIN WIRING



PERFORMANCE CHECK SHEET